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A Method of Evaluating Seeing Distances on a Curved Road and Its Application to Headlight Beams in Current Use

By V. J. JEHU, M.Sc., A.Inst.P.

Summary

A method is described by which direct seeing distances can be evaluated when two vehicles meet on a curved road at night. The method is a development of that already used to determine seeing distances from vehicles when they meet on a straight road. It has been applied to three headlighting systems in current use, the modern British beam, the symmetrical European beam, and the single-lamp meeting beam representing earlier British practice.

Considering meetings on both straight and curved roads, it is shown that in some circumstances the modern British system is better than the symmetrical European system, and that in others the order is reversed. The modern British system is almost always better than the European in revealing the important nearside object, and seeing for all object positions is considerably better during the early stages of a meeting on a curved road, when the observer is on the inside of the bend. This result is important, because the conditions closely resemble those of open-road driving with the meeting beam, a frequent occurrence on roads when oncoming vehicles are anticipated. Taking into consideration also the fact that the modern British system is the less susceptible to vertical misaim, it is concluded that it is the better suited to actual road conditions.

A comparison of the modern double-lamp British system with its predecessor, the single-lamp system, shows that on narrow roads, both straight and curved, the differences between the systems are generally small for all object positions. During the later stages of the meeting, however, recovery from the minimum seeing condition is consistently more rapid with the single lamps, for objects in the driver's own traffic lane.

(1) Introduction

In an earlier paper[1] a method was described by which seeing distances could be calculated for any combination of meeting beams, when two vehicles meet on a straight road at night. The method is based on an experimentally determined relationship between the beam intensity aimed at a specified object, the glaring intensity directed towards the observer, and the distance away at which the object can be recognised. In this paper it is shown how the same relationship can be used to calculate seeing distances, when the meeting between vehicles takes place on a curved road.

The method has been applied to the beams which were previously examined for the straight-road meeting[2]. They are the modern British beam, the symmetrical European beam, and the single-lamp meeting beam still used in Great Britain.

(2) Method of Calculation

In the case of the straight-road meeting, the basic data, giving the seeing distance of a specified object as a function of the illuminating intensity and the glaring intensity for a particular situation, were extended to other situations by means of the Stiles-Holladay relation, which states that the glaring effect of a light is directly proportional

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The manuscript of this paper was first received on April 26, 1956.

to the illumination at the observer's eyes and inversely proportional to the square of the angle between the direction of the light and the line of vision. The same technique can be used for meetings on a curved road, when allowance has been made for the differences in some of the parameters which occur between meetings on a bend and those on a straight road.

Three factors are affected by the changing direction of the curved road; they are the glaring intensities directed at the observer's eyes, the illuminating intensities aimed at the object, and the position of the object across the road in relation to the observer and the glare lamps. The first of these is a function of the distance between the observer and the glare lamps, the second is a function of the distance between the object and the observer's lamps, while the third is dependent on the relative positions of the observer, the object, and the glare lamps. All three depend on the radius of curvature of the road. Knowing the way in which these parameters vary with the relative positions of the object and the two opposing vehicles, the meeting on a curve can be converted into an equivalent meeting on a straight road in which the position of the object is not confined within the limits of the width of the road. The way in which this conversion is carried out is described in detail in the Appendix; it applies strictly only when the radius of curvature of the road is large.

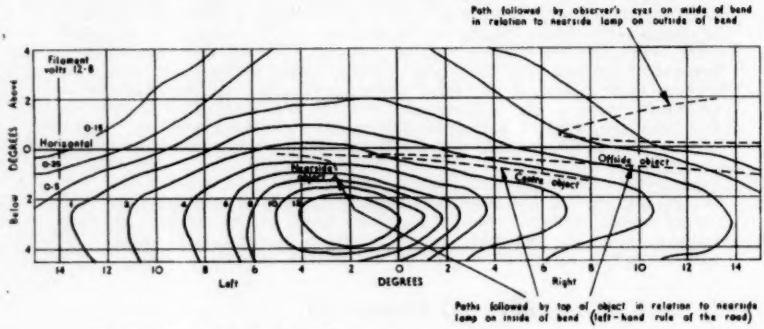

Path followed by observer's eyes on inside of bend in relation to nearside lamp on outside of bend
Filament volts 12·8
DEGREES Above
Below
Horizontal
Offside object
Nearside object
Centre object
Left
Right
DEGREES
Paths followed by top of object in relation to nearside lamp on inside of bend (left-hand rule of the road)

Fig. 1. Beam distribution from one lamp of the British meeting system.

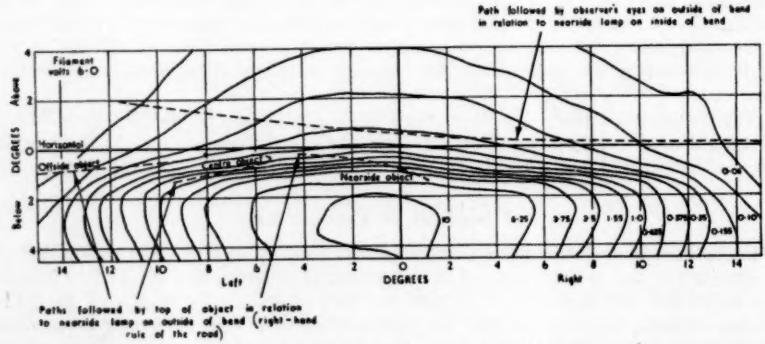

Path followed by observer's eyes on outside of bend in relation to nearside lamp on inside of bend
Filament volts 6·0
DEGREES Above
Below
Horizontal
Offside object
Centre object
Nearside object
Left
Right
DEGREES
Paths followed by top of object in relation to nearside lamp on outside of bend (right-hand rule of the road)

Fig. 2. Beam distribution from one lamp of the symmetrical European meeting system.

(3) Application of the Method

The situation considered for evaluation in this paper is that in which two vehicles meet on a road 20 ft. wide, with a radius of curvature of 1,500 ft., a value typical of a bend which is not extremely sharp but which is noticeably different from a straight road. In all other respects the situation is the same as the straight-road case already evaluated, except that only three positions across the road have been considered, the object in the path of the observer's vehicle having been omitted.

Table 1

Seeing distances for an object 18 in. high with a luminance factor of 7 per cent. for meetings on a road with a radius of curvature of 1,500 ft.

Observer on inside of bend

Object position	Distance between object and glare source (ft.)	Seeing distances with the following opposing beams: Double lamps — Modern British versus Modern British (ft.)	Double lamps — European versus European (ft.)	Single lamps — Modern British nearside raised 0.8 deg. versus same (ft.)
Nearside object	+ 500	252	136	255
	+ 300	249	129	251
	+ 200	160	88	154
	+ 150	135	97	148
	+ 100	155	105	176
	+ 50	181	112	203
	0	199	117	220
	— 50	210	122	228
	— 100	218	130	233
Object in centre of road	+ 500	254	163	257
	+ 300	253	162	255
	+ 200	247	157	247
	+ 150	226	147	221
	+ 100	112	110	113
	+ 50	71	84	73
	0	101	104	145
	— 50	150	131	191
	— 100	191	148	214
Offside object	+ 500	237	179	247
	+ 300	232	178	245
	+ 200	226	177	239
	+ 150	218	175	231
	+ 100	195	165	201
	+ 50	124	126	121
	0	< 50	< 50	< 50
	— 50	89	88	75
	— 100	144	130	144

Table 2

Seeing distances for an object 18 in. high with a luminance factor of 7 per cent. for meetings on a road with a radius of curvature of 1,500 ft.

Observer on outside of bend

Object position	Distance between object and glare source (ft.)	Seeing distances with the following opposing beams: Double lamps Modern British versus Modern British (ft.)	Double lamps European versus European (ft.)	Single lamps Modern British nearside raised 0.8 deg. versus same (ft.)
Nearside object	+ 500	196	175	194
	+ 300	191	174	189
	+ 200	175	172	173
	+ 150	158	170	160
	+ 100	142	164	147
	+ 50	137	157	147
	0	134	145	147
	— 50	137	139	154
	— 100	153	151	168
Object in centre of road	+ 500	173	152	169
	+ 300	155	150	150
	+ 200	89	139	72
	+ 150	71	118	< 50
	+ 100	63	89	< 50
	+ 50	58	80	57
	0	73	82	93
	— 50	102	105	121
	— 100	136	—	151
Offside object	+ 500	136	112	131
	+ 300	60	< 50	< 50
	+ 200	50	< 50	< 50
	+ 150	50	< 50	< 50

Each vehicle is assumed to be travelling in the centre of its own lane, so that the distance across the road when the axes of opposing sets of lamps become parallel is 10 ft.; the lamps on the vehicles are assumed to be 3 ft. apart, and their height above the road 30 in. The observer's eyes are assumed to be 7 ft. behind the lamps illuminating the object and 50 in. above the road, and the seeing distances are those for an object 18 in. high with a luminance factor of 7 per cent.

The beam distributions considered are shown in Figs. 1 and 2, which also show the paths followed by the observer's eyes, and by the top of the object, when the distributions are considered to be from the nearside glare lamp, and from the nearside lamp illuminating the object, respectively. Fig. 1 shows the paths appropriate to the situation when the observer is on the inside of the bend, and Fig. 2 the corresponding paths when the observer is on the outside of the bend, remembering that the symmetrical European beam is used when driving on the right-hand side of the road. The paths for the offside lamp have been omitted to avoid confusion.

(4) Results

Table 1 and 2 contain the seeing distances evaluated for the three types of meeting beam. Detailed comparisons of the results have been made between the modern British and symmetrical European beams, and between the British single- and double-lamp meeting beams.

(5) Modern British and Symmetrical European Beams

Fig. 3a shows the seeing distances obtained for the three object positions with the modern British system when the observer is on the inside of the bend. When the vehicles are far apart, glare from the other vehicle is less than on the straight road, and the observer's own lamps are directing more light at the nearside object, so that seeing distances are greater than on the straight road. As the vehicles approach

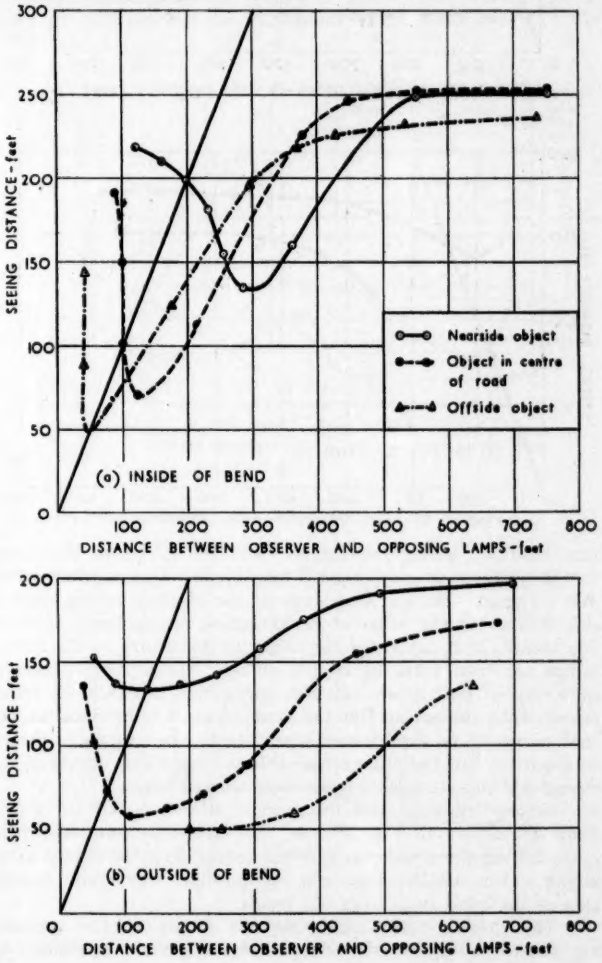
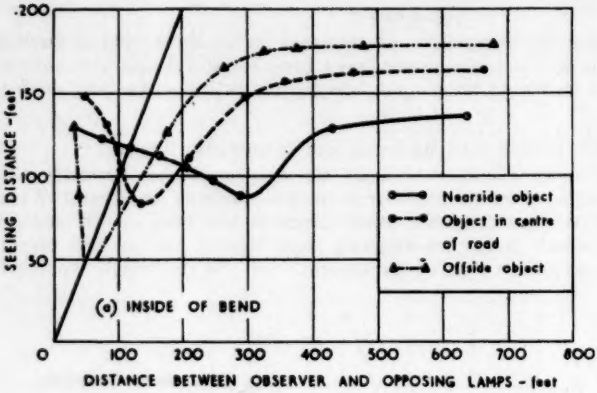


Fig. 3. Seeing distances on a curved road with the modern British meeting system.



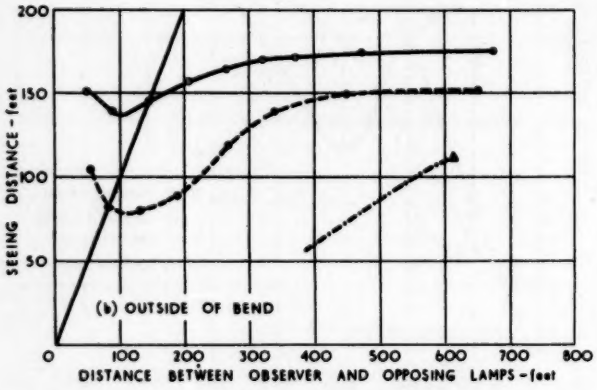


Fig. 4. Seeing distances on a curved road with the symmetrical European meeting system.

one another, seeing deteriorates until the lamps of the approaching vehicle appear to the observer to cross behind the object. This happens when the vehicles are about 300 ft. apart. Beyond this stage of the meeting seeing improves. The same pattern is followed for the other object positions, seeing being at its worst when the vehicles are about 120 ft. apart for the object in the centre of the road, and when the opposing lamps are level with the offside object. Subsequently, there is a rapid improvement in seeing in both cases. In this connection it should be remembered that the calculations take no account of the time taken for the eyes to recover from severe glare such as would be experienced when identifying objects in the centre and on the offside of the road; it is therefore reasonable to expect that curves of measured seeing distances would not rise so rapidly from their minima.

Seeing distances with the modern British system for a driver on the outside of a bend are shown in Fig. 3b. In this case the approaching lamps do not appear to cross behind the object, so that the seeing distance curves exhibit a gradual decline in seeing as the vehicles approach one another. Generally, seeing is worse from the outside of the bend than from the inside.

The corresponding seeing-distance curves for the symmetrical European system are shown in Fig. 4. Somewhat surprisingly the nearside object is seen later from

the inside of the bend than it is seen on a straight road. This is largely because the European beam, which is not deflected to the nearside, does not illuminate the nearside object so well from the inside of the bend. In fact, Fig. 4 shows that the nearside object is seen better when the observer is on the outside of the bend.

A comparison of Figs. 3 and 4 shows that when a meeting takes place on a bend, seeing distances fluctuate more for the British system than for the European system. This is particularly the case when the observer is on the inside of the bend. Differences in seeing conditions between the inside and outside of the bend also tend to be greater for the British system.

The performances of the two systems can be compared by evaluating the ratios of corresponding seeing distances, a method which eliminates the characteristics of the observer and the object. This has been done in Fig. 5, where curves below the ordinate value of 1.0 indicate that the British system is better than the European, and curves above the value 1.0 indicate that the European system is the better of the

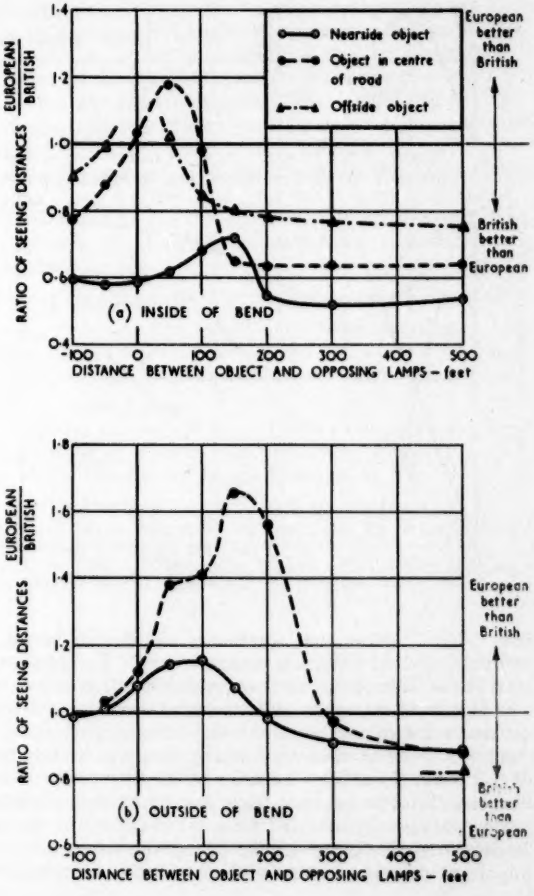


Fig. 5. Comparison of seeing distances on a curved road with the modern British and symmetrical European meeting systems.

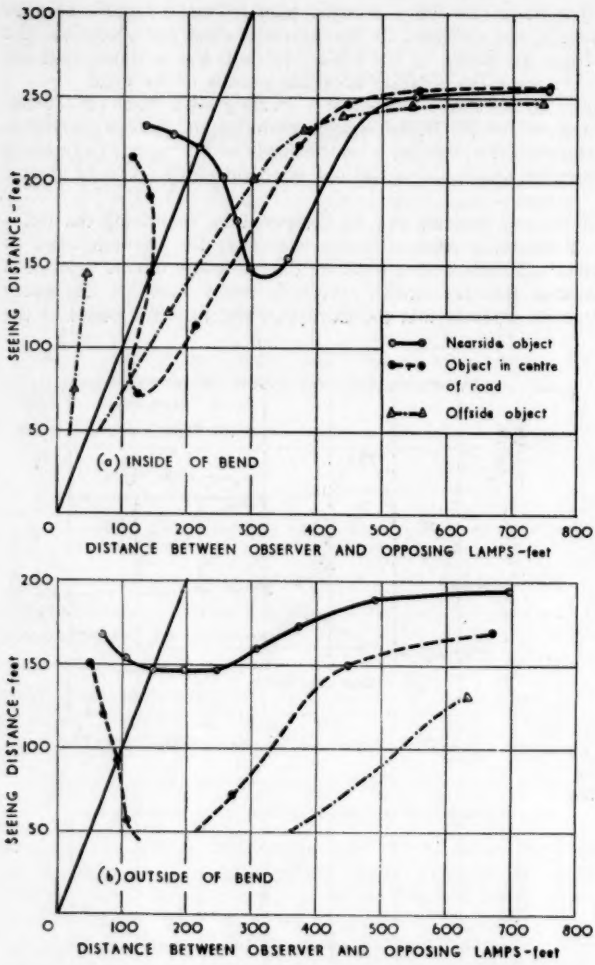


Fig. 6. Seeing distances on a curved road with the British single-lamp meeting system.

two. Fig. 5 shows that sometimes the British system is better than the European, and that at other times the reverse is true. Except for a short time when the observer is on the outside of the bend, the nearside object is seen better with the British system.

The most consistent difference between the systems occurs when the observer is on the inside of the bend and the vehicles are widely separated, a condition corresponding closely to open-road seeing with the meeting beam. Under this condition the British beam is markedly superior to the European for all positions of the object across the road. It follows that on fairly heavily trafficked roads, where drivers use the meeting beam continuously to avoid frequent switching of the headlights, seeing is better with the British system than with the European system. This, together with the facts that the important nearside object is almost always seen better with the British system, and

that it is less affected by vertical misaim(2), leads to the conclusion that it is the better suited of the two to actual road conditions, so far as seeing an object illuminated by one's own headlamps is concerned.

(6) British Single- and Double-Lamp Beams

The meeting beam from the modern double-dipping headlamp system has already been compared with its predecessor in this country, the system in which the meeting beam is provided by the nearside lamp only, for meetings on a straight road(2). In this paper the comparison is extended to meetings on a curved road. As before, the beam from the single lamp has been considered to be that obtained by raising the beam distribution of Fig. 1 by 0.8 deg.: the glaring intensity straight ahead in a horizontal plane is then the same as that from the correctly aimed double-lamp system.

Seeing-distance curves for this arrangement of opposing single lamps are given in Fig. 6. They show the same characteristics as the corresponding curves for the double-lamp system, the seeing distances varying considerably as the vehicles approach one another. Fig. 6a shows that when the object in the centre of the road is seen from the inside of the bend, a stage is reached where it is possible to see the object beyond the approaching vehicle, but not when it is closer to the vehicle, where it is hidden in the glare from the opposing lamps. Whether or not this condition will be observed in practice will depend on the time taken by the eye to recover from the glare.

Comparison of Figs. 3 and 6 shows that differences between the single- and double-lamp systems are small. They are most apparent during the later stages of the meeting when seeing distances are increasing, the single-lamp system offering a more rapid recovery of seeing than the double-lamp system. The superiority of the single-lamp system when the vehicles are fairly close together had previously been observed in the straight-road meeting(2). On wider roads the difference is likely to become less noticeable, and the double-lamp system might be preferred for the reason that it illuminates more of the road close to the vehicle.

(7) Conclusion

The characteristics of three types of meeting beam have been determined for meetings on a curved road, and considered together with those previously found for meetings on a straight road in a comparison of the performances of the beams.

Acknowledgment

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References

(1) Jehu. V. J. A Method of Evaluating Seeing Distances on a Straight Road for Vehicle Meeting Beams. Trans. Illum. Eng. Soc. (London), **20**, 57 (1955).
(2) Jehu, V. J. A Comparison of Some Common Headlight Beams for Vehicles Meeting on a Straight Road. Trans. Illum. Eng. Soc. (London), **20**, 69 (1955).

Appendix

In the straight-road case (Fig. 7) the glaring intensities directed towards the eyes of the observer at a distance d between the observer and the object are found by first determining the angles α_1 and α_2, which represent the sideways displacements of the observer from the two glare lamps, and also the angle β, which represents the angle between a horizontal plane and a plane joining the observer's eyes to the centres of the glare lamps.

To evaluate the beam intensities aimed at the top of the object at a specified distance d the values of the angles γ_1 and γ_2, which represent the sideways displacements of the centre of the object from the observer's lamps, are calculated together with the angle of dip δ between the lamps and the top of the object.

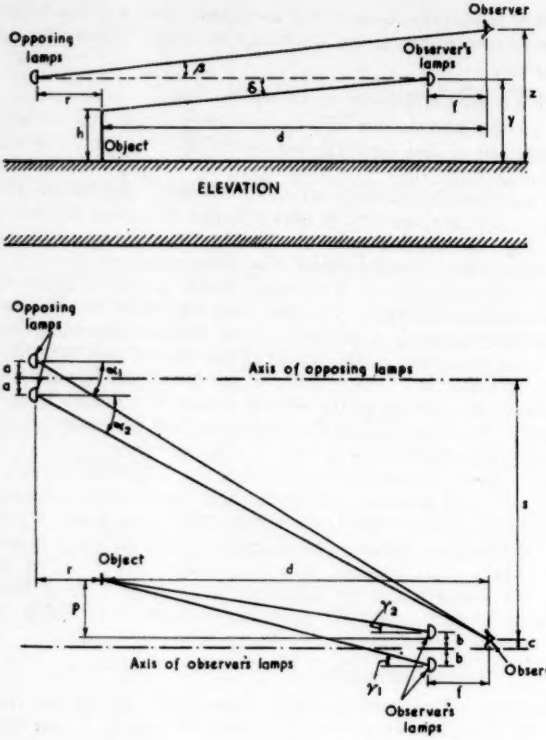

Fig. 7. The relative positions of observer, object and opposing lamps.

From Fig. 7

$$\tan \alpha_1 = \frac{s + a}{d + r}$$

$$\tan \alpha_2 = \frac{s - a}{d + r}$$

$$\tan \beta = \frac{z - y}{d + r}$$

$$\tan \gamma_1 = \frac{p + b + c}{d - f}$$

$$\tan \gamma_2 = \frac{p - (b - c)}{d - f}$$

$$\tan \delta = \frac{h - y}{d - f}$$

in which s and p have positive signs when measured to the right of the observer, and r is positive when the object is between the opposing lamps.

These angles are plotted on the beam distribution diagrams to determine the required beam intensities at specified values of d. The glaring intensities so obtained are multiplied by the glare multiplying factors to convert them into equivalent glaring intensities for the standard test situation.

Considering now the meeting between two vehicles on a curved road with a radius of curvature R (Fig. 8), when the vehicles are separated by a distance $(r + d - f)$, each set of lamps is rotated through an angle

$$\frac{\theta}{2},$$

$$\text{where } \frac{\theta}{2} = \frac{r + d - f}{2R} \text{ radians}$$

compared with the straight-road meeting, the distances r, d and f now being measured along the curve. To convert the meeting on a curved road to its equivalent meeting on a straight road, the angles α for the sideways displacements of the observer with respect to the glare lamps will be modified by the addition or subtraction of the appropriate values of $\frac{\theta}{2}$, depending on whether the observer is on the outside or the inside of the bend respectively. Thus, for the curved road

$$\alpha^1 = \alpha \pm \frac{\theta}{2}$$

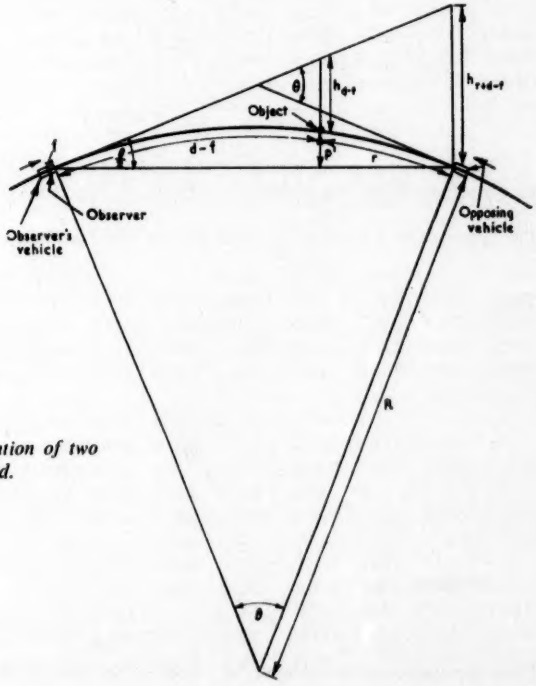

Fig. 8. Diagrammatic representation of two vehicles meeting on a curved road.

The distance across the road between the observer and the object, which was p on the straight road, becomes $p + p'$ on the curved road, where p' is a function of r and d. From Fig. 8

$$\frac{p' + h_{d-f}}{d - f} = \frac{\theta}{2} \text{ approx.}$$

$$p' = \frac{\theta}{2}(d - f) - h_{d-f} \text{ approx.}$$

Again from Fig. 8

$$\frac{h_{r+d-f}}{r + d - f} = \frac{\theta}{2} \text{ approx.}$$

$$h_{r+d-f} = \frac{\theta}{2}(r + d - f) \text{ approx.}$$

$$= \frac{(r + d - f)^2}{2R} \text{ approx.}$$

Similarly

$$h_{d-f} = \frac{(d - f)^2}{2R} \text{ approx.}$$

Hence

$$p' = \frac{r + d - f}{2R}(d - f) - \frac{(d - f)^2}{2R} \text{ approx.}$$

$$= \frac{r(d - f)}{2R} \text{ approx.}$$

Compared with the straight-road case the angles γ for the sideways displacements of the object from the observer's lamps are affected by the addition or subtraction of the appropriate values of $\frac{\theta}{2}$, and also by the fact that p is now replaced by $(p + p')$.

Thus

$$\gamma^1 = \frac{(p + p') + b + c}{d - f} - \frac{\theta}{2} \text{ for the inside of the bend,}$$

$$= \frac{p + \dfrac{r(d - f)}{2R} + b + c}{d - f} - \frac{(r + d - f)}{2R}$$

$$= \frac{p + b + c}{d - f} - \frac{(d - f)}{2R}$$

Similarly,

$$\gamma^1 = \frac{p + b + c}{d - f} + \frac{(d - f)}{2R} \text{ for the outside of the bend.}$$

Thus the values of the angles α^1 and γ^1 for the curved road can be obtained from

the angles α and γ for the straight road by adding and subtracting the appropriate values of the expressions

$$\frac{r + d - f}{2R} \text{ and } \frac{d - f}{2R} \text{ respectively.}$$

Since the expression for the distance across the road between object and observer changes from p for the straight road to $(p + p')$ for the curved road, it also follows

Table 3

Values of glare multiplying factor

Observer on inside of bend

Object position p (ft.)	Glare lamp position x (ft.)	Observer position d (ft.)	Glare multiplying factor at the following values of r								
			+500 (ft.)	+300 (ft.)	+200 (ft.)	+150 (ft.)	+100 (ft.)	+50 (ft.)	0 (ft.)	—50 (ft.)	—100 (ft.)
		50	0.065	0.288	0.266	0.259	0.275	0.328	0.460	—	—
		100	0.026	0.467	1.914	1.018	0.624	0.488	0.469	0.551	—
− 3.75	10.75	150	0.017	0.209	3.533	3.429	1.108	0.616	0.472	0.453	0.537
		200	0.013	0.122	1.437	10.89	1.971	0.750	0.473	0.392	0.397
		250	0.010	0.083	0.687	7.152	3.855	0.908	0.474	0.347	0.314
		50	0.059	0.319	0.342	0.346	0.379	0.475	0.730	—	—
		100	0.024	0.342	2.454	1.791	1.039	0.777	0.743	0.915	—
− 3.75	7.75	150	0.016	0.163	1.857	6.937	2.237	1.046	0.748	0.711	0.884
		200	0.012	0.101	0.810	6.390	5.165	1.356	0.750	0.594	0.606
		250	0.009	0.071	0.446	2.559	14.25	1.759	0.752	0.511	0.454
		50	0.007	0.036	0.129	0.322	1.219	6.872	2.248	—	—
		100	0.008	0.050	0.213	0.630	3.407	10.26	2.290	1.120	—
+ 4.25	10.75	150	0.008	0.048	0.208	0.628	3.843	13.81	2.305	1.104	0.832
		200	0.007	0.043	0.177	0.517	3.010	20.83	2.312	1.005	0.713
		250	0.007	0.037	0.145	0.406	2.130	33.74	2.317	0.892	0.587
		50	0.007	0.032	0.107	0.243	0.769	5.352	7.339	—	—
		100	0.008	0.044	0.166	0.421	1.603	15.60	7.475	2.412	—
+ 4.25	7.75	150	0.008	0.043	0.162	0.415	1.647	20.94	7.523	2.357	1.574
		200	0.007	0.038	0.140	0.352	1.354	19.05	7.547	2.054	1.278
		250	0.006	0.033	0.117	0.287	1.052	13.84	7.562	1.733	0.990
		50	0.002	0.009	0.022	0.043	0.102	0.399	29.92	—	—
		100	0.004	0.017	0.049	0.097	0.241	0.948	30.47	3.384	—
+12.25	10.75	150	0.005	0.021	0.061	0.125	0.314	1.242	30.67	5.762	1.450
		200	0.005	0.021	0.064	0.130	0.329	1.311	30.77	6.305	1.624
		250	0.005	0.021	0.061	0.124	0.314	1.253	30.83	5.639	1.468
		50	0.002	0.008	0.021	0.038	0.085	0.283	4.576	—	—
		100	0.004	0.016	0.043	0.082	0.183	0.572	4.661	16.90	—
+12.25	7.75	150	0.004	0.019	0.053	0.102	0.231	0.703	4.691	79.11	3.533
		200	0.005	0.020	0.055	0.106	0.240	0.731	4.706	95.24	4.250
		250	0.004	0.019	0.053	0.102	0.231	0.707	4.715	61.47	3.620

that the values of the glare multiplying factor must be recalculated for the curved road, inserting the values of $(p + p')$ for p in the expression

$$(x - p)^2 + (y - h)^2 + \frac{2r}{d}\left[p^2 - xp - (y - h)(h - z)\right] + \frac{r^2}{d^2}\left[p^2 + (h - z)^2\right]$$

for the denominator of the glare term.

Table 4

Values of glare multiplying factor
Observer on outside of bend

Object position p (ft.)	Glare lamp position x (ft.)	Observer position d (ft.)	Glare multiplying factor at the following values of r								
			+500 (ft.)	+300 (ft.)	+200 (ft.)	+150 (ft.)	+100 (ft.)	+50 (ft.)	0 (ft.)	−50 (ft.)	−100 (ft.)
		50	0.005	0.020	0.047	0.077	0.133	0.243	0.460	—	—
		100	0.006	0.025	0.059	0.096	0.162	0.279	0.469	0.705	—
− 3.75	10.75	150	0.006	0.023	0.057	0.093	0.159	0.276	0.472	0.733	0.914
		200	0.005	0.021	0.051	0.085	0.146	0.262	0.473	0.803	1.128
		250	0.005	0.019	0.046	0.076	0.133	0.246	0.474	0.905	1.512
		50	0.006	0.022	0.054	0.091	0.167	0.334	0.730	—	—
		100	0.006	0.027	0.068	0.116	0.209	0.393	0.743	1.263	—
− 3.75	7.75	150	0.006	0.026	0.066	0.112	0.204	0.389	0.748	1.328	1.794
		200	0.006	0.023	0.059	0.102	0.187	0.366	0.750	1.502	2.427
		250	0.005	0.021	0.052	0.090	0.168	0.339	0.752	1.770	3.791
		50	0.037	0.236	0.643	1.122	2.140	3.611	2.248	—	—
		100	0.016	0.095	0.314	0.607	1.167	1.968	2.290	1.605	—
+ 4.25	10.75	150	0.011	0.058	0.180	0.347	0.701	1.389	2.305	2.487	1.644
		200	0.008	0.042	0.126	0.240	0.495	1.086	2.312	3.748	3.404
		250	0.007	0.033	0.094	0.181	0.378	0.892	2.317	5.856	8.978
		50	0.056	0.274	0.709	1.192	2.389	6.991	7.339	—	—
		100	0.017	0.115	0.440	0.975	2.294	5.177	7.475	4.191	—
+ 4.25	7.75	150	0.011	0.068	0.235	0.506	1.220	3.195	7.523	8.980	4.308
		200	0.009	0.048	0.157	0.338	0.788	2.253	7.547	21.05	16.89
		250	0.007	0.037	0.114	0.237	0.566	1.706	7.562	69.58	835.0
		50	0.035	0.042	0.067	0.101	0.190	0.588	29.92	—	—
		100	0.088	1.204	1.043	1.064	1.406	2.954	30.47	6.634	—
+12.25	10.75	150	0.026	0.306	2.480	7.239	9.290	10.76	30.67	99.68	3.773
		200	0.015	0.121	0.636	2.108	10.49	32.47	30.77	122.0	47.62
		250	0.011	0.071	0.305	0.843	3.494	31.61	30.83	18.35	46.82
		50	0.032	0.038	0.058	0.085	0.149	0.391	4.576	—	—
		100	0.104	1.015	0.668	0.654	0.794	1.332	4.661	119.3	—
+12.25	7.75	150	0.029	0.427	4.378	5.117	3.308	3.052	4.691	24.80	20.18
		200	0.016	0.149	1.061	5.195	15.60	6.506	4.706	6.716	37.88
		250	0.012	0.084	0.434	1.556	12.46	14.93	4.715	3.554	5.035

With the modified values of the angles α and γ, and of the glare multiplying factor, the meeting on a curved road is converted into an equivalent meeting on a straight road, so that the procedure already described for the straight-road meeting can be applied to evaluate seeing distances on the curved road. Thus, having found the equivalent glaring intensities appropriate to the standard situation, the experimentally determined data are used to obtain a curve relating the distance of the object from the observer, and the intensity which must be aimed at the object in order that it may be seen at that distance through the glare from the opposing lamps; the actual beam intensities aimed at the object by the observer's lamps are then plotted on the same axes. The intersection of these two curves determines the distance at which the 18-in. object will be seen for the particular arrangement of object, observer and glare source.

Specific values of r have been selected at each of the three values of p considered, and the above procedure for finding the seeing distance of the object applied at each value of r, both when the observer is on the inside and on the outside of the bend. In other words, at each of a number of separations of object and glare source along the road (different values of r), the observer's vehicle is moved forward until the distance is found at which the object can just be identified, this procedure being repeated for three object positions across the road (different values of p), for an observer on the inside and on the outside of the bend. Finally, the seeing distances d obtained are plotted against $(d + r)$, the distances of the oncoming lamps from the observer.

The Assumed Meeting Situation

The situation evaluated in this paper is that in which two vehicles meet on a road 20 ft. wide with a radius of curvature of 1,500 ft. The values assumed for the various parameters in the expression for the denominator of the glare term are as follows:—

$x = s + a = 10.75$ for the nearside glare lamp,
$x = s - a = 7.75$ for the offside glare lamp,
$p = -3.75$ for the nearside object,
$p = +4.25$ for the object in the centre of the road,
$p = +12.25$ for the object on the offside of the road,

in which p is considered to be positive when measured to the right of the observer,

$h = 1.5$ for the height of the object,
$y = 2.5$ for the height of the lamps,
$z = 4.17$ for the observer's eye height.

The values of r considered are + 500, + 300, + 200, + 150, + 100, + 50, 0, − 50, − 100, r being regarded as positive when the glare source is behind the object. Calculated values for the glare multiplying factor are given in Tables 3 and 4. These, being independent of the particular beam distributions, may be employed in evaluations of other beam distributions without recalculation.

Additions to the List of Members

The following applicants have been duly elected by the Council to membership in the Society and their names have been added to the list of membership:—

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ELECTION OF OFFICERS AND COUNCIL

SESSION 1957—1958 OFFICIAL NOTICE

IN accordance with the procedure specified in the Articles of the Society, a list of existing Officers and Members of Council, of vacancies occurring and of duly qualified persons nominated by the Council for vacancies about to occur in the offices of President, Vice-Presidents, Hon. Treasurer, Hon. Secretary, Hon. Editor of Transactions, and Ordinary Members of Council, is presented below for the information of the Members of the Society.

In the event of any Members desiring to put forward other names, the Council will be pleased to receive such nominations, which should be made in accordance with the following rule (Article 48):—

"After the issue of the Council's list, and not later than the 15*th day of April* next following, any ten Members (but no more than ten) may nominate any other duly qualified person to fill any such vacancy by delivering such nomination in writing to the Hon. Secretary, together with the written consent of such person to accept office if elected, but each such nominator shall be debarred from nominating any other person for the same office at such election"

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SESSION 1956—1957

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The names in italics are those of Officers or Members retiring in 1957. The date in parentheses after each name indicates the date of election to Office or Membership of the Council.

* Retiring after filling casual vacancy. Eligible for re-election.

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